AMENDMENTS TO THE CLAIMS

This Listing of Claims replaces all prior versions, and listings, of claims in this application.

1. (Currently Amended) A method, comprising:

imaging a plurality of markers in a first imaging modality, the plurality of markers implanted in a body;

determining first coordinates of the plurality of markers relative to a first beam isocenter;

imaging the plurality of markers in a second imaging modality; and

determining second coordinates of the plurality of markers relative to a second beam isocenter, wherein at least a plurality of said markers are implanted in soft tissue of the body.

2. (Original) The method of claim 1, wherein the first beam isocenter is a planned treatment beam isocenter and the second beam isocenter is a treatment machine beam isocenter at a time of treatment.

3. (Original) The method of claim 2, further comprising:

correlating the second coordinates with the first coordinates; and

calculating an offset between the first coordinates and the second coordinates for at least one of the plurality of markers.

4. (Previously Presented) The method of claim 2, wherein the first imaging modality is CT and the second imaging modality is one of kilo volt (kV) and mega volt (MV) imaging.

5. (Original) The method of claim 3, further comprising adjusting a position of the plurality of markers based on the calculated offset.

6. (Original) The method of claim 1, further comprising identifying one or more of the plurality of markers that are imaged in the second imaging modality.

7. (Original) The method of claim 6, wherein imaging the plurality of markers in the first imaging modality generates a first image and imaging the plurality of markers in the second imaging modality generates a second image.

8. (Previously Presented) The method of claim 7, wherein identifying one or more of the plurality of markers that are imaged in the second imaging modality comprises performing a 2D size and shape consistency test of a region of interest of the second image.

9. (Original) The method of claim 8, wherein the 2D size and shape consistency test comprises median filtering and connected component analysis.

10. (Previously Presented) The method of claim 8, wherein identifying one or more of the plurality of markers that are imaged in the second imaging modality comprises performing a 3D geometric consistency test of the region of interest of the second image.

11. (Previously Presented) The method of claim 10, wherein the 3D geometric consistency test comprises an epipolar coincidence constraint.

12. (Currently Amended) The method of claim 6, wherein identifying one or more of the plurality of markers includes identifying one or more non marker objects as one or more of the plurality of markers and wherein the method further comprises removing the one or more non marker objects from the image.

13. (Original) The method of claim 6, further comprising determining a position of one or more of the plurality of markers that are not imaged in the second imaging modality.

14. (Original) The method of claim 13, wherein the position is determined based on the relationship between the first coordinates and the second coordinates of the one or more of the plurality of markers that are imaged.

15. (Original) The method of claim 14, determining the position comprises:

estimating a rigid body transform; and

applying the rigid body transform to the first coordinates to estimate the position of the one or more of the plurality of markers not imaged in the second imaging modality.

16. (Original) The method of claim 13, wherein the position is determined manually by a user.

17.-48. (Canceled)

49. (Currently Amended) An apparatus, comprising:

means for imaging a plurality of markers in a first imaging modality, the plurality of markers implanted in a body;

means for determining first coordinates of the plurality of markers relative to a first beam isocenter of a first beam source of the first imaging modality;

means for imaging the plurality of markers in a second imaging modality; and

means for determining second coordinates of the plurality of markers relative to a second beam isocenter of a second beam source of the second imaging modality, wherein the first imaging modality is an x-ray imaging modality, the first beam isocenter is an isocenter of an x-ray image system, the second imaging modality is an x-ray imaging modality, and the second beam isocenter is a high energy beam of radiation of a treatment machine.

50. (Previously Presented) The apparatus of claim 49, wherein the first beam isocenter is a planned treatment beam isocenter and the second beam isocenter is a treatment machine beam isocenter at a time of treatment.

51. (Previously Presented) The apparatus of claim 50, further comprising:

means for correlating the second coordinates with the first coordinates; and

means for calculating an offset between the first coordinates and the second coordinates for at least one of the plurality of markers.

52. (Previously Presented) The apparatus of claim 51, further comprising means for adjusting a position of the plurality of markers based on the calculated offset.

53. (Previously Presented) The apparatus of claim 49, further comprising means for identifying one or more of the plurality of markers that are imaged in the second imaging modality.

54. (Currently Amended) A system, comprising:

a first beam source to generate an imaging beam having a first beam isocenter;

a second beam source to generate a treatment beam having a second beam isocenter;

a first imager coupled to receive the imaging beam, the first imager to image a plurality of markers, implanted in a body, in a first imaging modality;

a second imager coupled to receive the treatment beam, the second imager to image the plurality of markers in a second imaging modality; and

a computer coupled to the first and second imagers, the computer to determine first coordinates of the plurality of markers relative to the first beam isocenter and determine second coordinates of the plurality of markers relative to the second beam isocenter, wherein the first imaging modality is an x-ray imaging modality, the first beam isocenter is an isocenter of an x-ray image system, the second imaging modality is an x-ray imaging modality, and the second beam isocenter is a high energy beam of radiation of a treatment machine.

55. (Previously Presented) The system of claim 54, wherein the first imager is the second imager.

56. (Currently Amended) The method of claim 1, wherein implanting comprises injecting the markers into soft tissue of the body using a needle.

57. (Currently Amended) The method of claim 1, wherein implanting comprises expelling the markers into soft body tissue.

58. (Previously Presented) The method of claim 1, wherein imaging the plurality of markers in the first imaging modality occurs during a first treatment session, and imaging the plurality of markers in the second imaging modality occurs during a different second treatment session.

59.-61. (Canceled)

62. (Previously Presented) The method of claim 1 further comprising:

adjusting a position of a target volume within the body relative to a treatment beam using the plurality of internal markers imaged using the first imaging modality having an external source and the second imaging modality having an external source.

63. (Previously Presented) The method of claim 1 further comprising:

estimating an adjustment to at least one of the body and a treatment beam in a treatment session, based on a determination of any change of spacing between imaged markers implanted in a target, over a course of treatment, and based on a number of visible markers in the imaged markers.

64. (Previously Presented) The method of claim 63, further comprising estimating a number of positioning images needed for the treatment session based on a determination of any change of spacing between imaged markers implanted in a target, over a course of treatment, and based on the number of visible markers in the image.

65. (Previously Presented) The method of claim 63, wherein the target is rigid and the number of visible markers is at least one.

66. (Previously Presented) The method of claim 65, wherein the adjustment is a patient position adjustment.

67. (Previously Presented) The method of claim 65, wherein the adjustment is a Multi-Leaf Collimator (MLC) position adjustment.

68. (Previously Presented) The method of claim 63, wherein the target is rigid and the number of visible markers is at least two.

69. (Previously Presented) The method of claim 68, wherein the adjustment is a patient orientation adjustment.

70. (Previously Presented) The method of claim 68, wherein the adjustment is a Multi-Leaf Collimator (MLC) rotation adjustment.

71. (Previously Presented) The method of claim 63, wherein the target is deformable and the number of visible markers is three or more.

72. (Previously Presented) The method of claim 71, wherein the adjustment is a Multi-Leaf Collimator (MLC) shape.

73. (Previously Presented) The method of claim 64, wherein the target is rigid and the number of visible markers is three or more, and wherein the number of positioning images is two or more from different view angles suitable for triangulation.

74. (Previously Presented) The method of claim 64, wherein the target is deformable and the number of visible markers is three or more, and wherein the number of positioning images is at least one from a same view angle as a treatment beam angle.

75. (Previously Presented) The method of claim 64, wherein the target is deformable and the number of visible markers is three or more, and wherein the number of positioning images is two or more from different view angles suitable for triangulation.

76. (Previously Presented) The method of claim 1, further comprising emitting signals from the imaging sources of the first and second imaging modalities.

77. (Previously Presented) The method of claim 1, wherein the imaging sources of the first and second imaging modalities are located on one or more gantries.

78. (Previously Presented) The method of claim 9, wherein filtering comprises taking median intensity values of perimeter pixels around a center pixel being evaluated and subtracting the median intensity values from the center pixel to generate a filtered output pixel intensity value.

79. (Previously Presented) The method of claim 78, wherein the perimeter pixels are pixels on a perimeter of an approximate circle around the center pixel.

80. (Canceled)

81. (Previously Presented) The method of claim 79, wherein the radius of the approximate circle is greater than a width of the marker.

82. (Previously Presented) The method of claim 1, wherein the first beam isocenter is a treatment planning machine planned treatment beam isocenter during a treatment planning stage, the second beam isocenter is a treatment machine beam isocenter during a treatment, and the treatment planning machine and the treatment machine are different machines.

83. (Previously Presented) The method of claim 1, wherein the first imaging modality is one of a CT imaging, a kilo volt imaging, and a mega volt imaging.

84. (Previously Presented) The method of claim 1, wherein one imaging source of the first imaging modality is located on a gantry of a treatment planning machine, and an imaging source of the second imaging modality is located on a different treatment machine.

85. (Previously Presented) The method of claim 1, further comprising measuring radiation received by at least one of the plurality of markers during a treatment session.

86. (Previously Presented) The method of claim 58 further comprising measuring radiation received by at least one of the markers during the first treatment session and during the second treatment session.

87. (New) The method of claim 1 further comprising:

implanting the plurality of markers into soft tissue by expelling the markers into the soft tissue of the body using a needle;

treating the body with high energy radiation of the high energy treatment beam.